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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
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EXAMINER

NGIVEN, T

ART UNIT

PAPER NUMBER

2815

DATE MAILED:

10/26/01

**Please find below and/or attached an Office communication concerning this application or proceeding.**

**Commissioner of Patents and Trademarks**

# Office Action Summary

Application No.

09/826,661

Applicant(s)

HU, YONGJUN

Examiner

Joseph Nguyen

Art Unit

2815

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☐ Responsive to communication(s) filed on \_\_\_\_.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 31-70 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 31-70 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 04/05/01 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

## Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

## Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 3.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other:

## DETAILED ACTION

### *Drawings*

The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, the limitation "multiple contact holes" must be shown or the feature(s) canceled from the claim(s). No new matter should be entered. ✓

### *Claim Rejections - 35 USC § 112*

The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 63 and 64 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. The phrase "the layer is planar within 50% and 20%" is not distinctly and concisely disclosed in the specification in such a way one having ordinary skill in the art could make and use.

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claim 38 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. It is not clear how and in what magnitude applicant regards as

"a minimal amount of the silicon". This limitation should be disclosed in a measurable dimension. ✓

***Claim Rejections - 35 USC § 102***

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

Claims 31-34, 36-37, 39-47, 55-58 are rejected under 35 U.S.C. 102(e) as being anticipated by Miyamoto.

Regarding claims 31, 39, 55, Miyamoto discloses on figure 3 a contact hole for a semiconductor device comprising "a bottom surface of a first material [1]; at least one vertical sidewall of a second material [2]; a generally planar layer of a third material [6] covering the bottom surface, the third material including at least two different constituent elements".

Regarding claim 32, Miyamoto discloses the third material 6 is an alloy or a composite (col. 8, line 49).

Regarding claim 33, Miyamoto discloses the third material 6 contains a refractory metal (col. 8, line 49).

Regarding claim 34, Miyamoto discloses third material 6 is a silicide (col. 8, line 49).

Regarding claim 36, Miyamoto discloses the stoichiometry of the third layer 6 is uniform (col. 5, lines 3-4).

Regarding claim 37, Miyamoto discloses on figure 3 the first material 1 is silicon.

Regarding claim 40, Miyamoto discloses on figure 3 a height of the sidewall is at least four times a width of the bottom surface (col. 9, lines 4-8).

Regarding claim 41, Miyamoto discloses a width of the bottom surface is equal or less than about 0.5 microns (col. 9, line 6).

Regarding claim 42, Miyamoto discloses on figure 3 the third material 6 is substantially confined to the bottom surface of the hole.

Regarding claim 43, Miyamoto discloses on figure 3 a contact hole for a semiconductor device comprising "a bottom surface of a first material [1]; at least one vertical sidewall of a second material [2]; a generally planar layer of a third material [6] covering the bottom surface with a thickness variation of less than 50% [col.5, lines 3-4], the third material including at least two different constituent elements".

Regarding claims 44 -45, Miyamoto discloses the thickness variation of the layer is less than about 20% and 10% (col. 5, lines 3-4).

Regarding claim 46, Miyamoto discloses on figure 3 the planar layer 6 contacts the sidewalls.

Regarding claim 47, Miyamoto discloses on figure 3 the planar layer 6 does not extend to a substantial distance up the sidewall from the bottom.

Regarding claim 56, Miyamoto discloses the insulator 2 is an oxide (col. 8, line 37).

Regarding claim 57, Miyamoto discloses on figure 3 the layer of the third does not extend substantially up the sidewall from the bottom.

Regarding claim 58, Miyamoto discloses the third material 6 is a silicide.

Claims 31-35, 37- 38, 42, 48, 50- 54, 56- 58 are rejected under 35 U.S.C. 102(e) as being anticipated by Chen.

Regarding claims 31, 39, 55, Chen discloses on figure 3B a contact hole for a semiconductor device comprising "a bottom surface of a first material [31]; at least one vertical sidewall of a second material [33]; a generally planar layer of a third material [36] covering the bottom surface, the third material including at least two different constituent elements".

Regarding claim 32, Chen discloses the third material 36 is an alloy or a composite (col. 3, line 44).

Regarding claim 33, Chen discloses the third material 36 contains a refractory metal (col. 3, line 44).

Regarding claim 34, Chen discloses third material 36 is a silicide (col. 3, line 44).

Regarding claim 35, Chen discloses the third material 36 is rich in titanium (col. 3, line 44).

Regarding claim 37, Chen discloses on figure 3B the first material 31 is silicon.

Regarding claim 38, Chen discloses the third layer consumes only a minimal amount of the silicon (col. 4, lines 11-12).

Regarding claim 42, Chen discloses on figure 3B the third material 36 is substantially confined to the bottom surface of the hole.

Regarding claim 48, Chen discloses on figure 3B a contact hole for a semiconductor device comprising "a bottom surface of a first material [31]; at least one vertical sidewall of a second material [33]; a generally planar layer of a third material [36] having a graded stoichiometry (col. 4, lines 7-12) between two different elements".

Regarding claim 50, Chen discloses the first material 31 is silicon.

Regarding claim 51, Chen discloses the second material 33 is an insulator.

Regarding claim 52, Chen discloses the planar layer 36 contacts the sidewalls.

Regarding claim 53, Chen discloses the third material 36 is substantially confined to the bottom of the hole.

Regarding claim 54, Chen discloses the third material 36 is a silicide.

Regarding claim 56, Chen discloses the insulator 33 is a glass.

Regarding claim 57, Chen discloses on figure 3B the layer of the third does not extend substantially up the sidewall from the bottom.

Regarding claim 58, Chen discloses the third material 6 is a silicide.

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claim 49 is rejected under 35 U.S.C. 103(a) as being unpatentable over Chen as applied to claim 48 above, and further in view of Miyamoto.

Regarding claim 49, Chen discloses substantially all the structure set forth in the claimed invention except the hole having a high aspect ratio. However, Miyamoto discloses on figure 3 the hole having a high aspect ratio (col. 9, lines 3-8). In view of such teaching, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Miyamoto by having the hole having a high aspect ratio for the purpose of providing a good coverage over a surface of the silicon substrate.

Claims 59- 64 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen or Miyamoto in view of Thomas et al.

Regarding claims 59- 64, Chen or Miyamoto discloses substantially all the structure set forth in the claimed invention except multiple contact holes. However, Thomas et al disclose on figures 3 multiple contact holes in an integrated circuit. In view of such teaching, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Chen or Miyamoto by having multiple contact holes for the purpose of obtaining a plurality of interconnects in an integrated circuit.

Claims 65-70 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen and Miyamoto in view of Thomas et al.



Regarding claims 65- 70, Chen and Miyamoto discloses substantially all the structure set forth in the claimed invention except multiple contact holes. However, Thomas et al disclose on figures 3 multiple contact holes in an integrated circuit. In view of such teaching, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Chen and Miyamoto by having multiple contact holes for the purpose of obtaining a plurality of interconnects in an integrated circuit.

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

US Patent 5723382 to Sandhu et al disclose that a contact structure having titanium silicon on the bottom surface of the contact hole.

US Patent 5911113 to Yao et al disclose a process for fabricating metal plugs.

### ***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Joseph Nguyen whose telephone number is (703) 308-1269. The examiner can normally be reached on Monday-Friday, 7:30 am- 4:30 pm

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie Lee can be reached on (703) 308-1690. The fax phone numbers for the organization where this application or proceeding is assigned is (703) 308-7382 for regular communications.

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Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

JN  
October 23, 2001

A handwritten signature in black ink, appearing to read 'Eddie Lee', is positioned above the printed name and title.

**EDDIE LEE**  
**SUPERVISORY PATENT EXAMINER**  
**TECHNOLOGY CENTER 2800**